FOREST PRODUCTS
Project Fact Sheet

SELECTION AND DEVELOPMENT OF METALLIC AND REFRACTORY MATERIALS FOR BLACK LIQUOR AND BIOMASS GASIFICATION

BENEFITS

- Provides higher thermal efficiencies
- Increases electrical output per unit of fuel by up to three times
- Decreases emissions of CO_2, SO_2, and other species
- Saves about 900 trillion Btu of energy by 2020
- Avoids conditions for excessive deposits
- Generates significant net operating savings
- Improves safety
- Lowers capital costs

APPLICATIONS

There are a number of Tomlinson boilers in the industry reaching the end of their useful life. This provides a good opportunity to replace this equipment with the new technology. There will also be a significant global market for this technology.

Longer-Life Materials Are Needed for Commercial Combined-Cycle Gasifiers

Pulp and paper can be produced more economically if more efficient processes are available to recover chemicals and energy from the black liquor by-product of kraft pulping. Black liquor gasification systems are being studied as alternatives to the traditional Tomlinson recovery boilers. Biomass is also potentially important as a fuel in gasification systems. Widespread adoption of black liquor and biomass gasification technologies is considered a priority by the industry. However, serious problems exist or are anticipated with the materials available for commercial combined-cycle gasification systems when they use these by-products as gasifier fuels.

Operation of the only commercial-scale, black liquor gasifier in operation, located in New Bern, North Carolina, indicated that better materials are needed for the refractory lining and metal support structure for the lining. The liquor injection system needs improvement and there is concern that pilot scale unit materials will not be adequate in the scaled-up systems. Although there is no operating experience for oxygen-blown, high-temperature, high-pressure black liquor gasification systems, serious materials problems are likely to be encountered here also. There is also limited experience with operating biomass gasification units, but reports from the McNeil Station's atmospheric-pressure, indirectly heated wood waste gasifier in Burlington, Vermont indicate attrition of the silica and some refractory problems in this unit.

Estimates suggest that implementation of improved gasification systems in the forest products industry could produce energy savings of about 900 trillion Btu by 2020. These systems provide a lower capital investment and drop net operating costs by $12 to $17 million per year, translating into significant savings when compared to the conventional Tomlinson recovery furnace. Additional benefits include reductions in the air emissions of CO_2, SO_2, and other waste products.

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ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

PROJECT DESCRIPTION

Goal: To identify metallic and refractory materials with an acceptable lifetime that will improve the operation of three types of commercial gasifiers using black liquor or biomass feed stocks.

Six tasks have been identified for this four-year effort, which will be carried out by an industrial technical team representing industry, universities, and government laboratories. Task 1 will be the characterization of gasifier environments to determine the physical operating conditions. Computer modeling studies will be carried out where operating systems are not available. Task 2 will be characterization of refractory degradation to determine the reaction of individual refractory materials to the gasifier environment. Task 3 will involve development of a refractory screening test to improve testing of actual operating conditions. Task 4 will primarily be concerned with laboratory testing and modeling of the degradation of metals in gasifiers using techniques such as optical microscopy, electron microprobes, and X-ray diffraction. Task 5 will be the selection and development of alternate metallic and refractory materials that can withstand gasifier environments. In Task 6, Systems Materials Development, studies will be conducted to overcome materials problems that arise with newly developed gasifier systems.

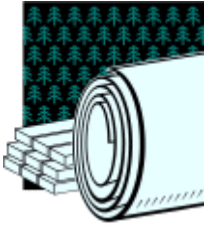
PROGRESS & MILESTONES

The following milestones have been identified for reaching the objectives of this research effort:

- Evaluate initial degradation mechanism of current refractories and alloys (year 1).
- Initiate testing of new/alternate improved refractories and metallic alloys (year 2).
- Evaluate gasifier environment (year 2).
- Develop refractory screening test and begin validation experiments (year 3).
- Identify gasifier environment by modeling and experiments (year 3).
- Complete materials evaluation of key systems including heat exchangers (year 4).
- Determine type of refractories and metallic alloys that are optimally suited for use in gasifiers; prepare report (year 4).

Completed Work

- Studies are continuing in which samples of selected refractories are being exposed to molten smelt at 1000 C under an inert atmosphere.
- A series of mullite-based refractories were exposed and evaluations are being conducted for consideration in selecting the refractory lining for use in the rotary refractory test system.
- A rotary refractory test furnace was designed and ordered that permits the refractory to operate under a temperature gradient while rotationg so that molten smelt washes across the surface of the refractory under a gaseous atmosphere that simulates that of a black liquor gasifier.
- Installation of the ventilation system and the hydrogen sulfide detection and alarm system is nearing completion.



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